

TITLE OF THE INVENTION
Registration of Communications Devices

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CROSS-REFERENCE TO PROVISIONAL APPLICATION

[0002] This patent claims the benefit of United States Provisional Patent Application No. 60/397,962, filed July 23, 2002 and entitled "Method to Enable the SMS Service for the Subscribers Converted From GAIT TDMA Native to GAIT GSM Native," and this provisional patent application is incorporated herein by reference in its entirety.

CROSS-REFERENCE TO RELATED APPLICATION

[0003] This patent also relates to the commonly-assigned U.S. Patent X,XXX,XXX (Application No. XX/XXX,XXX, filed July 22, 2003,) entitled "Messaging Service for Communications Devices (docket number C02-0053-001), of which the "Brief Summary of the Invention" and the "Detailed Description of the Invention" sections are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0004] This invention generally relates to mobile communications and, more particularly, to methods for registering subscribers by communicating subscription profiles from a GSM communications network to a TDMA/CDMA communications network.

2. Description of the Related Art

[0005] Registration is a concern for mobile telecommunications service providers. Each time a subscriber enters a new coverage zone within a mobile switching center, and when a registration timer expires, the subscriber must register with the mobile switching center. The process of registration involves communicating the subscriber's subscription profile from the subscriber's Home Location Register to the mobile switching center. This subscription profile is used to process incoming and outgoing communications for the subscriber. A problem arises, however, when the subscriber's Home Location Register cannot be accessed by the mobile switching center. If the Home Location Register cannot be accessed, then the subscriber cannot register and, thus, the subscriber cannot send and/or receive communications.

[0006] A "foreign communications network" is an example. If the subscriber is trying to register with a foreign communications network, sometimes that foreign communications network cannot access the subscriber's Home Location Register. When, for example, a subscriber is activated in a Global System for Mobile (GSM) communications network, neither a Time Division Multiple Access (TDMA) communications network nor a Code Division Multiple Access (CDMA) communications network may be able to access the subscriber's Home Location Register. Because the GSM, TDMA, and CDMA communications networks operate using different signaling standards, the subscriber's Home Location Register may not be accessible to a foreign communications network using a different signaling standard. When, then, a foreign communications network is encountered, the registration process sometimes fails and the subscriber cannot send and receive communications.

[0007] Migration of subscribers is another example. Sometimes a telecommunications service provider will move, or "migrate," a subscriber's subscription profile from one network standard to another network standard. The subscriber's subscription profile, for example, may be migrated from a TDMA/CDMA communications network to a GSM communications network. After the subscriber's subscription profile is migrated, the TDMA/CDMA communications network must be re-provisioned to find and to access the subscriber's subscription profile on the GSM communications network. If the TDMA/CDMA communications network is not re-provisioned to find the subscriber's subscription profile, the registration process might fail, thus preventing the subscriber from sending and/or from receiving communications.

[0008] There is, accordingly, a need in the art for improved registration of subscribers, a need for improved methods and systems of accessing a subscriber's Home Location Register, a need for methods and systems to register a subscriber with a foreign communications network, and a need for improved methods and systems of migrating subscribers from one network to another network.

BRIEF SUMMARY OF THE INVENTION

[0009] The aforementioned problems, and other problems, are reduced by methods and systems to register a subscriber to a communications network. This invention routes a registration request from a Time Division Multiple Access (TDMA) communications network, or from a Code Division Multiple Access (CDMA) communications network, to a Global System for Mobile (GSM) communications network. The routing of the registration request is based upon an International Mobile Subscriber Identity (IMSI) number associated with the subscriber. When the subscriber's subscription profile is maintained in the GSM communications network, this invention allows either the TDMA communications network or the CDMA communications network to obtain the subscriber's subscription profile. Even though the subscriber's subscription profile is maintained in the GSM communications network, this invention allows the subscriber to register and to send/receive communications signals using the TDMA communications network and/or the CDMA communications network. Thus, the subscriber has access to any TDMA, CDMA, and/or GSM communications network.

[0010] This invention discloses methods for registering a subscriber to a communications network. One method receives a registration request to access a first communications network. The registration request is routed to a second communications network based upon an international mobile subscriber identity number associated with the subscriber. The international mobile subscriber identity number allows the subscriber to register with the second communications network. When the first communications network operates using a Global System for Mobile communications signaling standard, the second communications network operates using either a Time Division Multiple Access signaling standard or a Code Division Multiple Access signaling standard. If the first communications network operates using the Time Division Multiple Access signaling standard, the second communications network operates using either the Global System for Mobile communications signaling standard or the

Code Division Multiple Access signaling standard. Similarly, when the first communications network operates using the Code Division Multiple Access signaling standard, the second communications network operates using either the Global System for Mobile communications signaling standard or the Time Division Multiple Access signaling standard.

[0011] Another embodiment of this invention describes another method for registering a subscriber to a communications network. Here a registration request is received at a mobile switching center, and the registration request is communicated from a subscriber to a Global System for Mobile communications network. The mobile switching center operates in either a Time Division Multiple Access communications network or a Code Division Multiple Access communications network. The registration request is forwarded to a Signaling Transfer Point and routed to an appropriate Home Location Register for that subscriber. The routing of the registration request, however, is based upon a mobile subscriber identification number associated with the subscriber. The mobile subscriber identification number allows either the Time Division Multiple Access communications network or the Code Division Multiple Access communications network to access the subscriber's information stored on the Home Location Register. The routing of the registration request may use global title translation in a signaling message from the Signaling Transfer Point. The global title translation would include the mobile subscriber identification number.

[0012] Another embodiment of this invention describes yet another method for registering a subscriber to a communications network. A registration request is received at a mobile switching center in a Global System for Mobile communications network. The registration request is received from a native subscriber. The term "native subscriber" means a subscriber whose communications service was activated in either a Time Division Multiple Access communications network or a Code Division Multiple Access communications network. The registration request is forwarded to a Signaling Transfer Point and routed to a Home Location Register. The routing of the registration request is based upon a mobile subscriber identification number associated with the native subscriber. The mobile subscriber identification number may be mapped, or referenced, to a signaling point code associated with the Home Location Register. The mobile subscriber identification number allows the Global System for Mobile communications network to access information associated with the native subscriber.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0013] These and other features, aspects, and advantages of this invention are better understood when the following Detailed Description of the Invention is read with reference to the accompanying drawings, wherein:

FIGS. 1 and 2 are block diagrams illustrating an embodiment of this invention;

FIG. 3 is a schematic illustrating an International Mobile Subscriber Identity (IMSI) number associated with a subscriber according to an embodiment of this invention;

FIGS. 4 and 5 are block diagrams illustrating a Code Division Multiple Access (CDMA) communications network obtaining a subscriber's subscription profile from a Global System for Mobile (GSM) communications network according to an embodiment of this invention;

FIG. 6 is a flowchart illustrating a method for registering a subscriber to a communications network according to an embodiment of this invention;

FIG. 7 is a schematic illustrating a non-limiting example of migrating a subscriber from a Time Division Multiple Access (TDMA) communications network to a Global System for Mobile (GSM) communications network according to an embodiment of this invention;

FIG. 8 is a flowchart illustrating another non-limiting example for registering a subscriber to a communications network according to an embodiment of this invention; and

FIG. 9 is a schematic illustrating still another non-limiting example for registering a subscriber to a communications network according to an embodiment of this invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] This invention now will be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. These embodiments are provided so that this disclosure will be thorough and complete and will fully convey the scope of the invention to those of ordinary skill in the art. Moreover, all statements herein reciting embodiments of the invention, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known

equivalents as well as equivalents developed in the future (*i.e.*, any elements developed that perform the same function, regardless of structure).

[0015] Thus, for example, it will be appreciated by those of ordinary skill in the art that the diagrams, schematics, illustrations, and the like represent conceptual views or processes illustrating systems and methods embodying this invention. The functions of the various elements shown in the figures may be provided through the use of dedicated hardware as well as hardware capable of executing associated software. Similarly, any switches shown in the figures are conceptual only. Their function may be carried out through the operation of program logic, through dedicated logic, through the interaction of program control and dedicated logic, or even manually, the particular technique being selectable by the entity implementing this invention. Those of ordinary skill in the art further understand that the exemplary hardware, software, processes, methods, and/or operating systems described herein are for illustrative purposes and, thus, are not intended to be limited to any particular named manufacturer.

[0016] This invention provides methods for registering a subscriber to a communications network. This invention routes a registration request from a Time Division Multiple Access (TDMA) communications network, or from a Code Division Multiple Access (CDMA) communications network, to a Global System for Mobile (GSM) communications network. The routing of the registration request is based upon an International Mobile Subscriber Identity (IMSI) number associated with the subscriber. When the subscriber's subscription profile is maintained in the GSM communications network, this invention allows either the TDMA communications network or the CDMA communications network to obtain the subscriber's subscription profile. Even though the subscriber's subscription profile is maintained in the GSM communications network, this invention allows the subscriber to register and to send/receive communications signals using the TDMA communications network and/or the CDMA communications network. Thus, the subscriber has access to any TDMA, CDMA, and/or GSM communications network.

[0017] FIGS. 1 and 2 are block diagrams illustrating an embodiment of this invention. A registration request 10 is communicated from a subscriber's communications device 12. The subscriber's communications device 12 operates using a Global System for Mobile (GSM)

communications signaling standard. The term "communications device," as used herein, encompasses a mobile terminal (sometimes called "mobile station" or "mobile equipment"), a personal data assistant (PDA), a computer, a camera, a digital music device, or any other device that sends/receives communications signals. A first communications network 14 receives the registration request 10, and the registration request 10, in general terms, requests access to the first communications network 14. The first communications network 14 includes a base station 16, a TDMA Mobile Switching Center 18, and a TDMA Signaling Transfer Point 20. Although the subscriber's communications device 12 operates using the Global System for Mobile communications signaling standard, the first communications network 14, however, operates using a Time Division Multiple Access (TDMA) signaling standard. FIG. 1, then, shows the GSM subscriber's communications device 12 attempting to register with the first TDMA communications network 14.

[0018] The subscriber's appropriate Home Location Register 22 must be queried. The Home Location Register 22 is a database that stores subscription profiles for multiple subscribers. As FIG. 1 shows, however, the subscriber's appropriate Home Location Register 22 is maintained in a second communications network 24. This second communications network 24 operates using the Global System for Mobile (GSM) communications signaling standard. Because the Home Location Register 22 is maintained in the second GSM communications network 24, the Home Location Register 22 stores each subscriber's subscription profiles according to an International Mobile Subscriber Identity (IMSI) number associated with each subscriber. If an individual subscriber's International Mobile Subscriber Identity number is known, the Home Location Register 22 may be queried for that subscriber's subscription profile.

[0019] The registration request 10, then, is routed to the subscriber's appropriate Home Location Register 22. When the first communications network 14 receives the registration request 10 from the subscriber's communications device 12, the registration request 10 includes an International Mobile Subscriber Identity (IMSI) number 26 associated with the subscriber. This International Mobile Subscriber Identity number 26 is then used to construct a signaling message 28. This signaling message 28 is used to identify and to locate the subscriber's Home Location Register 22. The first communications network 14 routes the registration request 10, with the signaling message 28, to the second communications network 24 and on to the subscriber's Home Location Register 22. The registration request 10, with the

signaling message 28, typically routes via a Public Switched Telecommunications Network 30. The registration request 10 and the signaling message 28, however, may also route along private networks. The registration request 10 and the signaling message 28 route along the Public Switched Telecommunications Network 30 to a Destination Signaling Transfer Point 32, to a Destination Mobile Switching Center 34, and then to the subscriber's Home Location Register 22. The registration request 10 and the signaling message 28 could alternatively directly route from the Destination Signaling Transfer Point 32 to the subscriber's Home Location Register 22. Because the registration request 10 includes the International Mobile Subscriber Identity number 26 associated with the subscriber, the Home Location Register 22 may retrieve the subscriber's subscription profile 36.

[0020] The embodiment continues with FIG. 2. Once the subscriber's subscription profile 36 is retrieved, the subscription profile 36 is then returned to the first communications network 14 via the Public Switched Telecommunications Network 30. Although the subscriber's subscription profile 36 is maintained in the second communications network 24 (using the GSM signaling standard), this invention allows the first communications network 14 (using the TDMA signaling standard) to retrieve that subscription profile 36. Because the first communications network 14 now has access to the subscriber's subscription profile 36, the subscriber may register with the first communications network 14.

[0021] The registration request 10, as mentioned above in general terms, requests access to the first communications network 14. The registration request 10 initiates a process of authenticating the subscriber's communications device 12 and of updating the current location of the communications device 12. Because the registration process for the communications device is well known in the art, this patent will not further discuss the registration request 10. If, however, the reader desires more information on the registration process, the reader is directed to the following sources: LAWRENCE HARTE *et al.*, GSM SUPERPHONES 150-52 & 170-73 (1999); JÖRG EBERSPÄCHER *et al.*, GSM SWITCHING, SERVICES AND PROTOCOLS 40 (2001); and JOACHIM TISAL, GSM CELLULAR RADIO TELEPHONY 80-83 (1997), with each incorporated herein by reference.

[0022] As those of ordinary skill in the art also understand, the Home Location Register 22 stores the subscriber's subscription profile. The subscriber's subscription profile may include

subscription service information, authentication information, and current location information. Because the physical and functional characteristics of the Home Location Register 22 are well known in the art, this patent will not further discuss the Home Location Register 22. If, however, the reader desires more information on the registration process, the reader is directed to the following sources: SIEGMUND REDL *et al.*, GSM AND PERSONAL COMMUNICATIONS HANDBOOK 248-51 (1998); LAWRENCE HARTE *et al.*, GSM SUPERPHONES 139-40, 150-52 & 170-73 (1999); JÖRG EBERSPÄCHER *et al.*, GSM SWITCHING, SERVICES AND PROTOCOLS 38-39 (2001); GUNNAR HEINE, GSM NETWORKS: PROTOCOLS, TERMINOLOGY, AND IMPLEMENTATION 31-38 (1999); ASHA MEHROTRA, GSM SYSTEM ENGINEERING 54-55 (1997); and JOACHIM TISAL, GSM CELLULAR RADIO TELEPHONY 79-80 (1997), with each incorporated herein by reference.

[0023] FIG. 3 is a schematic illustrating the International Mobile Subscriber Identity (IMSI) number 26 associated with the subscriber. As those of ordinary skill in the art recognize, each GSM subscriber is assigned the International Mobile Subscriber Identity number 26. The International Mobile Subscriber Identity number 26 includes a Mobile Country Code (MCC) 38, a Mobile Network Code (MNC) 40, and a Mobile Station Identification Number (MSIN) 42. The Mobile Country Code 38 identifies the subscriber's country of domicile. The Mobile Network Code 40 identifies the subscriber's home mobile network (*e.g.*, the subscriber's *Public Land Mobile Network*), and the Mobile Station Identification Number 42 identifies the subscriber within that home mobile network. Because the structural coding for the International Mobile Subscriber Identity number 26 is well known in the art, this patent will not further discuss the Mobile Subscriber Identity number 26. If, however, the reader desires more information, the reader is directed to the following sources: SIEGMUND REDL *et al.*, GSM AND PERSONAL COMMUNICATIONS HANDBOOK 350 (1998); JÖRG EBERSPÄCHER *et al.*, GSM SWITCHING, SERVICES AND PROTOCOLS 32 (2001); GUNNAR HEINE, GSM NETWORKS: PROTOCOLS, TERMINOLOGY, AND IMPLEMENTATION 191-93 (1999); ASHA MEHROTRA, GSM SYSTEM ENGINEERING 40-43 (1997); and JOACHIM TISAL, GSM CELLULAR RADIO TELEPHONY 80-83 (1997), with each incorporated herein by reference.

[0024] FIGS. 4 and 5 are block diagrams illustrating another embodiment of this invention. Here the first communications network 14 operates using a Code Division Multiple Access (CDMA) signaling standard, while the subscriber's communications device 12 operates using the Global System for Mobile (GSM) communications signaling standard. The first

communications network 14 includes a CDMA base station 44, a CDMA Mobile Switching Center 46, and a CDMA Signaling Transfer Point 48. The subscriber's Home Location Register 22 is maintained in the second communications network 24, and the second communications network 24 operates using the Global System for Mobile communications signaling standard. When the first communications network 14 receives the registration request 10, the registration request 10 includes the International Mobile Subscriber Identity (IMSI) number 26 associated with the subscriber. The signaling message 28 is constructed using the International Mobile Subscriber Identity number 26. The first communications network 14 routes the registration request 10 and the signaling message 28 to the second communications network 24 via the Public Switched Telecommunications Network 30. The registration request 10 and the signaling message 28 route along the Public Switched Telecommunications Network 30 to the Destination Signaling Transfer Point 32, to the Destination Mobile Switching Center 34, and then to the subscriber's Home Location Register 22. The registration request 10 and the signaling message 28 could alternatively directly route from the Destination Signaling Transfer Point 32 to the subscriber's Home Location Register 22. Because the registration request 10 includes the International Mobile Subscriber Identity number 26 associated with the subscriber, the Home Location Register 22 may retrieve the subscriber's subscription profile 36. The Home Location Register 22 retrieves the subscriber's subscription profile 28 and, as FIG. 5 shows, the subscription profile 28 is returned to the first communications network 14. Although the subscriber's subscription profile 36 is maintained in the second communications network 24 (using the GSM signaling standard), this invention allows the first communications network 14 (using the CDMA signaling standard) to retrieve the subscription profile 36. Because the first communications network 14 now has access to the subscriber's subscription profile 36, the subscriber may register with the first communications network 14.

[0025] FIG. 6 is a flowchart illustrating one method for registering a subscriber to a communications network. A registration request is received (Block 50) to access a first communications network. The first communications network may operate using a Time Division Multiple Access signaling standard (Block 52) or a Code Division Multiple Access signaling standard (Block 54). The registration request is routed to a second communications network (Block 56), and the routing of the registration request is based upon an International Mobile Subscriber Identity (IMSI) number associated with the subscriber. The International Mobile Subscriber Identity (IMSI) number may include a Mobile Subscriber Identification Number

(Block 58). The second communications network operates using a Global System for Mobile communications signaling standard. The International Mobile Subscriber Identity number allows the subscriber to register with the first communications network.

EXAMPLE #1

[0026] This invention is further illustrated by the following non-limiting example. FIG. 7 shows how the methods of this invention may be used to "migrate" a subscriber from a Time Division Multiple Access (TDMA) communications network to a Global System for Mobile (GSM) communications network. The subscriber's communications device 12, in this embodiment, is a "dual-mode" GSM-ANSI Interoperability Team (GAIT) device that can operate in both the first TDMA communications network 14 and in the second GSM communications network 24. When, however, the subscriber's subscription profile 36 is moved, or "migrated," from a TDMA Home Location Register 60 to the GSM Home Location Register 22, network routing must be modified. As those of ordinary skill in the art understand, a TDMA communications network uses NPA-NXX based routing protocols to locate a subscriber's Home Location Register. A GSM communications network, on the other hand, uses a routing scheme based upon the subscriber's International Mobile Subscriber Identity (IMSI) number. If the first TDMA communications network 14 uses NPA-NXX based protocols, the registration request 10 would incorrectly route to the TDMA Home Location Register 60. This NPA-NXX based protocol scheme would fail to locate the subscriber's migrated GSM Home Location Register 22 in the second GSM communications network 24.

[0027] FIG. 7, then, shows an Interworking and Interoperability Function 62. The Interworking and Interoperability Function 62 provides a signaling interface between the first TDMA communications network 14 and the second GSM communications network 24. This Interworking and Interoperability Function 62 enables service access when a subscriber operates in a foreign communications network, and that foreign communications network has a signaling protocol that is different from the subscriber's home communications network protocol. When the first communications network 14 receives the registration request 10, the registration request 10 is routed to the Interworking and Interoperability Function 62. The Interworking and Interoperability Function 62 then provides an interface with the second GSM communications network 24 and, thus, the subscriber's subscription profile 36 stored in the

GSM Home Location Register 22. The subscriber's subscription profile 36 is retrieved and returned to the first communications network 14, allowing the subscriber to register with the first communications network 14.

EXAMPLE #2

[0028] This invention is further illustrated by another non-limiting example. FIG. 8 is a flowchart illustrating another method for registering a subscriber to a communications network. This example re-provisions a Signaling Transfer Point to obtain a subscription profile from a Global System for Mobile (GSM) communications network. The subscriber's subscription profile is stored on a GSM Home Location Register (HLR) (Block 64). A Signaling Transfer Point is enabled to use Mobile Subscriber Identification Number-based (MSIN-based) Global Title Translation (GTT) (Block 66). The Signaling Transfer Point may operate within a Time Division Multiple Access (TDMA) communications network (Block 68) or a Code Division Multiple Access communications network (Block 70). The Signaling Transfer Point is provisioned so that the subscriber's Mobile Subscriber Identification Number (MSIN) is mapped to a Signaling Point Code (SPC) of the subscriber's GSM Home Location Register (HLR) (Block 72). As those of ordinary skill in the art understand, the Signaling Point Code is a unique code that is assigned to each node in an SS7 network. A GSM Signaling Transfer Point, in the GSM communications network, is enabled to use International Mobile Subscriber Identity (IMSI) number-based Global Title Translation (GTT) when routing a registration request (Block 74). The GSM Signaling Transfer Point is also provisioned so that the International Mobile Subscriber Identity (IMSI) number associated with the subscriber is mapped to a Signaling Point Code (SPC) of an Interworking and Interoperability Function (IIF) signaling interface (Block 76). The subscriber's registration request is then routed to the GSM Home Location Register (Block 78). The subscriber's subscription profile is retrieved (Block 80), and the subscription profile is returned to the TDMA/CDMA Signaling Transfer Point (Block 82). The subscriber may now register with the TDMA/CDMA communications network (Block 84).

EXAMPLE #3

[0029] This invention is further illustrated by yet another non-limiting example. FIG. 9 is a flowchart illustrating another method for registering a subscriber to a communications network.

This example again concerns GSM-ANSI Interoperability Team (GAIT) subscribers. That is, those subscribers whose communications device is a "dual-mode" device operable in both a TDMA communications network and in a GSM communications network. This example provides a method of identifying a GAIT subscriber and of ensuring the subscriber's Home Location Register is located and accessed. Here a unique Mobile Subscriber Identification Number range is utilized for GAIT subscribers that are migrating. Until the subscriber expresses a desire to migrate, all settings are as originally configured. The Mobile Subscriber Identification Number is assigned to the unit with over the air without disturbing mobile directory number settings. The flowchart of FIG. 9 permits the telecommunications service provider to forego any additional equipment purchase when migrating the subscriber.

[0030] As FIG. 9 shows, a GAIT subscriber is assigned a Mobile Subscriber Identification Number Block Identifier (MBI) (Block 86). This Mobile Subscriber Identification Number Block Identifier (MBI) would preferably only store GAIT subscribers (Block 88). The Mobile Subscriber Identification Number Block Identifier would preferably not have geographic significance (Block 90). A Signaling Transfer Point (STP) is enabled to use Mobile Subscriber Identification Number-based (MSIN-based) Global Title Translation (GTT) (Block 92). The Mobile Subscriber Identification Number Block Identifier (MBI) is directed to the Interworking and Interoperability Function by the GTT result (Block 94). When a TDMA subscriber is migrated to GSM, the subscriber's Mobile Subscriber Identification Number (MSIN) now points to the Interworking and Interoperability Function to allow for conversion to International Mobile Subscriber Identity (IMSI) number for Location Updates (Block 96). The International Mobile Subscriber Identity (IMSI) number is used to originate a Location Update (Block 98), and this Location Update is converted to a registration notification at the Interworking and Interoperability Function (Block 100). This registration notification is then forwarded to the Home Location Register (Block 102).

[0031] While this invention has been described with respect to various features, aspects, and embodiments, those skilled and unskilled in the art will recognize the invention is not so limited. Other variations, modifications, and alternative embodiments may be made without departing from the spirit and scope of this invention.